

2816

ChemRisk/Shonka Research Associates, Inc., Document Request Form

(This section to be completed by subcontractor requesting document)

Requestor Debbie Shonka 1 Site Records (Called in verbally to Emmo McCastill)
Document Center (is requested to provide the following document)

Date of request 1/25/96 Expected receipt of document _____

Document number KGD-916 Date of document 11/7/73

Title and author (if document is unnumbered)

(This section to be completed by Document Center)

Date request received 1/25/96

Date submitted to ADC 1/31/96

Date submitted to HSA Coordinator 1/25/96

(This section to be completed by HSA Coordinator)

Date submitted to CICO 1/31/96

Date received from CICO 2/1/96

Date submitted to ChemRisk/Shonka and DOE 2/1/96

(This section to be completed by ChemRisk/Shonka Research Associates, Inc.)

Date document received _____

Signature _____

SAYLOR

UNCLASSIFIED

No.

2816

U48641

~~CONFIDENTIAL~~

K25RC

K-GD-916

PLANT RECORDS
RECEIPT NO.
AF 123

DECLASSIFIED --

by authority of: *W. Selby* 1/31/96 (K-25/LMES)
CG PED # *Classification Specialist*

(Authorized Declassifier's name and organization)

1/31/96
(date)

(Person making change)

1/31/96
(date)

(Document identification verified by)

CONTAINMENT OF RELEASED URANIUM HEXAFLUORIDE (U)

R. L. Ritter

Materials and Systems Development Department
Gaseous Diffusion Development Division

TO:

~~SECRET~~
ST K25
Date 1-22-91

November 7, 1973

UNION
CARBIDE

OAK RIDGE GASEOUS DIFFUSION PLANT
OAK RIDGE, TENNESSEE

Classification changed UNCLASSIFIED
(level and category)

prepared for the U.S. ATOMIC ENERGY COMMISSION
under U.S. GOVERNMENT Contract W-7405 eng 26

John Pashley 1/31/96
ABC or ADD signature (first reviewer) Date
Thomas W. Selby 1/31/96
ADD signature (final reviewer) Date

RESTRICTED DATA

This document contains Restricted Data as defined in the Atomic Energy Act of 1954. Its dissemination or disclosure to any unauthorized person is prohibited.

UNCLASSIFIED

~~CONFIDENTIAL~~

John Pashley
Classifying Official
Materials and Systems Development
Department Superintendent

Title of Position
This document has been approved for release to the public by:

T.W. Selby 1/31/96
Technical Information Officer Date
Oak Ridge K-25 Site
10/10/84

UNCLASSIFIED

KGD-916
Page 2

~~CONFIDENTIAL~~

CONTAINMENT OF RELEASED URANIUM HEXAFLUORIDE

BY R. L. RITTER

INTRODUCTION

Efforts were made to determine the distribution of the reaction products resulting from releases and to evaluate the effectiveness of the cell housing in containing these products. These efforts included visual observation of the atmosphere, both inside and outside of the cell housing, measurement of particulate fallout, again both inside and outside of the cell housing, and measurement of air alpha activities at several locations above and surrounding the cell housing and on the building roof at the vents where air is discharged from the building to the atmosphere.

Visual Observations

When uranium hexafluoride is released into moist air at room temperature, rapid hydrolysis occurs producing uranyl fluoride and hydrogen fluoride. Under these conditions, these hydrolysis products are readily visible as a dense white cloud. No information was available on the visual appearance of a uranium hexafluoride release at the temperature prevailing within the cell enclosure, which varied from about 160°F at the point of release (3 feet above the floor) to about 172°F near the top of the cell housing for the first seven tests, and from an estimated 175°F near the release point of about 188°F near the top of the housing for the remainder of the tests. A window was installed in the cell housing wall, to permit visual observation of the uranium hexafluoride releases in this series of tests. No white cloud was observed at the point of release for any of the releases inside the cell housing for release rates up to 100 g/min. Instead, a general haze developed within 5 to 10 minutes, both inside the

UNCLASSIFIED

~~CONFIDENTIAL~~

UNCLASSIFIED

K-6D-916
Page 3

~~CONFIDENTIAL~~

cell housing and in the area of the building above the cell housing. The haze above the cell housing developed more slowly and was not as dense as that inside the housing. During some releases at rates of less than 5 g/min, no haze was visible inside or outside of the cell housing for releases for periods as long as 30 minutes. The Pyr-A-Larm detectors consistently alarmed before any visual evidence of the release was noted. Thus, visual observation is not considered a reliable method of detecting a uranium hexafluoride release inside a cell housing or of estimating the amount of uranium-containing material present in the surrounding building atmosphere.

The visual appearance of uranium hexafluoride releases outside of the cell housing in a compressor bearing tunnel was similar to ^{that} ~~those~~ described above at room temperature, i.e., the typical white smoke was visible at the point of release. The distribution of this smoke is discussed in the section concerning the detection of uranium hexafluoride releases from high-pressure compressor seals.

Particulate Fallout

In tests 1 and 2, shallow pans of 1-sq ft area were placed at sixteen locations on the floor inside the cell housing. Analyses of uranium-containing particles collected on these pans indicated that the large majority of particulate fallout inside a cell housing occurs within a few feet of the release point. The fallout in pans located at distances greater than one stage removed from the release point was not significantly different than the background fallout measured prior to the test. Quantitative measurements of total particulate fallout within a cell housing

UNCLASSIFIED

~~CONFIDENTIAL~~

~~UNCLASSIFIED~~

K-GD-916
Page 4

~~CONFIDENTIAL~~

were not possible because of uncertainties in the total area on which the particulate matter was deposited.

In tests 39, 40, 43, 44, and 45, similar shallow pans of 1 sq ft area were placed at various locations outside the cell housing to evaluate the particulate fallout in these areas.

No #

The locations of the 12 pans are shown in figure _____. The pans were placed in position 1 hour before a test and left in place a total of 24 hours before removal for analyses for total uranium. The results of the five tests are shown in table _____. The background value of 2 to 4 ^{μg} U/sq ft/24-hr was measured prior to release number 1.

It can be seen that, for release rates of 50 g/min or less, continued for a period of 15 minutes, the particulate fallout at floor level (pans 8, 9, and 10) and at the level of the top of the compressor housing (pans 7 and 11) in a 24-hour period is negligible. Some fallout did occur at these levels for the 98 g/min release. Significant quantities of particulate fallout occurred on top of the cell housing (pans 1, 2, 3, and 4) and on the catwalk above and to the east of the cell housing (pans 5 and 6) in all of the releases. In addition, slight fallout was observed on the building roof (pan 12) for the 50 g/min and 98 g/min releases. The reason for the very small fallout observed during test 43, a 10 g/min release, is unknown. It should be noted that no alarms were observed during this test.

These data indicate that particulate fallout should not present a hazard to operating personnel on the cell floor for release rates of 50 g/min or

UNCLASSIFIED

~~CONFIDENTIAL~~

UNCLASSIFIED

~~CONFIDENTIAL~~

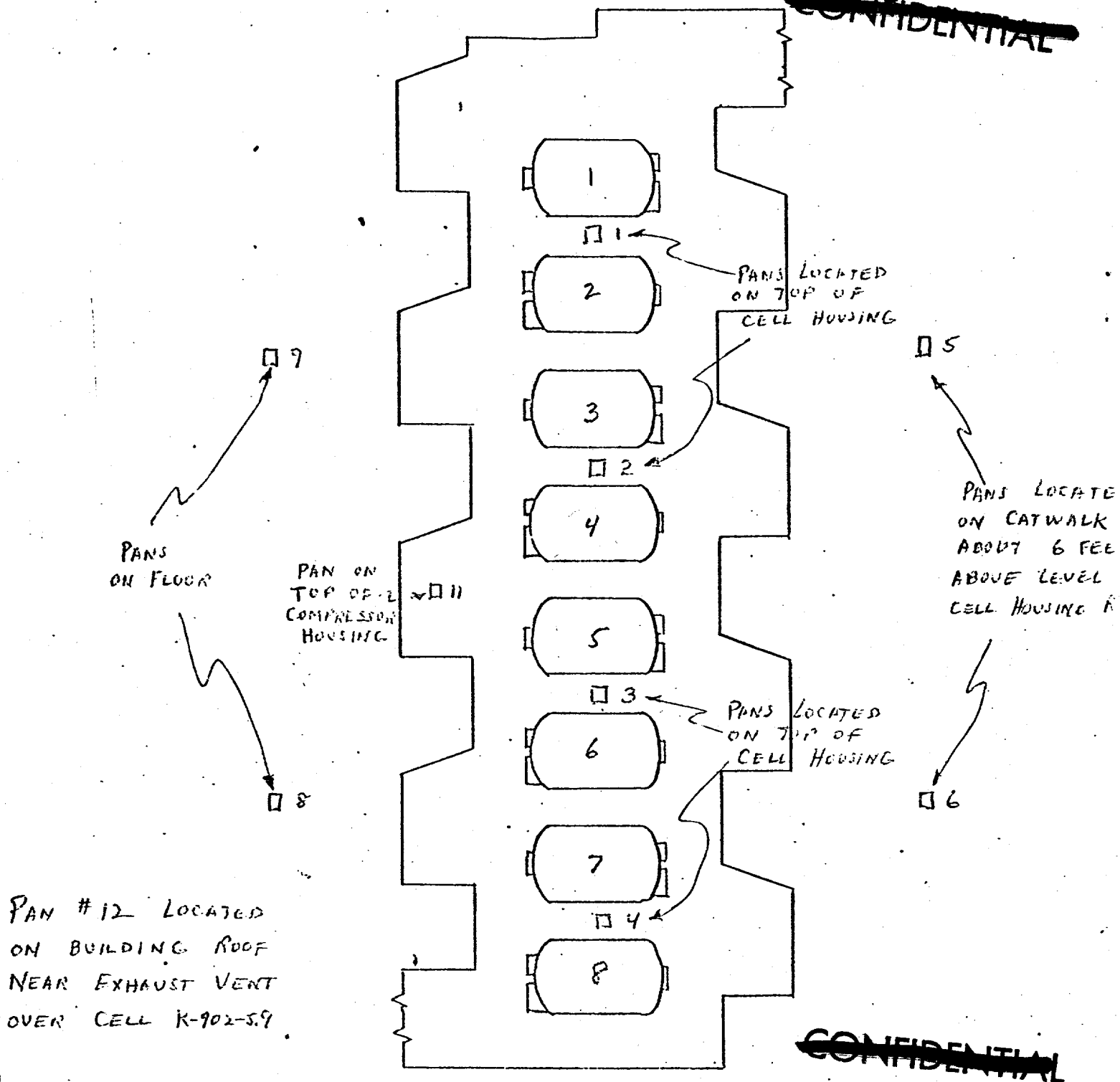


FIGURE ____ LOCATIONS AT WHICH PARTICULATE FALLOUT WAS MEASURED OUTSIDE OF CELL K-902-S9

UNCLASSIFIED

TABLE

~~CONFIDENTIAL~~

URANIUM ANALYSES OF PARTICULATE MATERIAL COLLECTED IN PANS
OUTSIDE OF CELL K-902-5.9

Test Number	UF ₆ Release Rate*, g/min	Pan Analyses, $\mu\text{g U/sq ft/24-hr}^{**}$											
		1	2	3	4	5	6	7	8	9	10	11	12
39	98	22	108	57	31	56	8	5	10	18	14	7	13
40	50	16	62	19	14	24	18	3	5	4	6	4	15
43	10	6	6	3	2	2	2	1	2	7	2	1	3
44	10	6	18	38	4	12	4	3	4	5	5	2	-
45	5	2	58	26	2	8	4	3	3	6	2	4	-

* Releases were continued for a period of 15 minutes.

** Background between 2 and 4 $\mu\text{g U/sq ft/24-hr}$.

UNCLASSIFIED

~~CONFIDENTIAL~~

UNCLASSIFIED

~~CONFIDENTIAL~~

smaller inside the cell enclosure for release periods of 15 minutes or less. Protective respiratory equipment should probably be employed by personnel on the cell floor for release rates greater than 50 g/min and for releases of longer duration than 15 minutes, and for all releases for personnel on the cell housing roof or at higher elevations in the building.

Air Alpha Activity

Air alpha activities were measured at several locations surrounding and above the cell housing during fourteen of the release tests. Air sampling was started when the release was initiated and usually continued for 30 minutes, although some samples were collected for longer time intervals. The results are summarized in table _____. Air samples were usually collected at more than one position on the cell floor and on the top of the cell housing; the alpha activities reported in table _____ are the maximum observed values. The plant allowable limit (PAL) for alpha activity is 2 counts/min/cu ft.

The PAL was exceeded on the cell floor in only two runs, at release rates of 50 and 104 g/min for periods of 15 minutes. However, it was exceeded in every test on top of the cell housing. In one test, at a release rate of 78 g/min, the PAL was exceeded on top of the compressor housing. These results verify the conclusions presented above in regard to the wearing of protective respiratory equipment.

Estimation of Containment Efficiency of Cell Housing

An attempt was made in seven of the release tests to estimate the efficiency of the cell housing in containing the released material. Measurements were

UNCLASSIFIED

~~CONFIDENTIAL~~

UNCLASSIFIED

~~CONFIDENTIAL~~

TABLE

AIR ALPHA ACTIVITIES MEASURED DURING URANIUM HEXAFLUORIDE RELEASES

Test	Release Rate, g UF ₆ /min	Release Location	Duration of Release, min	Maximum Air Alpha Activity, cts/min/cu ft		
				Cell Floor	On Top of Compressor Housing	On Top of Cell Housing
2	5.2	Inside Cell	61	0.17	0.19	2.87
10	5.5	Inside Cell	30	0.25	-	-
11	5.8	Inside Cell	25	0.12	-	2.09
44	10	Inside Cell	15	0.52	-	7.60
4	10.9	Inside Cell	30	0.17	-	-
3	11.6	Inside Cell	31	0.19	0.16	3.62
8	11.7	Inside Cell	35	0.36	-	1.48
41	20	Inside Cell	15	1.54	-	7.29
42	20	Inside Cell	15	0.04	-	3.20
40	50	Inside Cell	15	3.56	-	17.47
7	78.3	Inside Cell	16	0.55	2.43	2.55
39	98	Inside Cell	15	0.84	-	17.13
16	104	Inside Cell	16	2.19	-	5.25
31	20	Bearing Tunnel	22	0.47	-	-

UNCLASSIFIED

~~CONFIDENTIAL~~

~~CONFIDENTIAL~~
UNCLASSIFIED

made of the alpha activity of the air leaving the building through the roof vent directly over cell K-902-5.9. These measurements were continued after termination of the release for a time period long enough to ensure that the air leaving the building contained insignificant quantities of uranium. The results of these measurements are presented in table ____.

Difficulty was encountered in measuring the quantity of air leaving through the building vent. An average air velocity of 900 ft/min was employed in the calculation, although relatively large variations were observed in the velocity when scanned over the 32 sq ft area of the vent. In addition, runs 7, 8, and 16 were made with the louvers on the vent in the 10% open position, in which case even larger variations in the air velocity were observed when scanned over the area of the vent opening. In all of the calculations, a total air flow of 28,800 cu ft/min leaving the building vent was employed. The possibility of a difference in uranium content in the air near ~~this~~ ^{the} center of the vent, where all data for table ____ were taken, and the air exiting near the vent wall cast some doubt on the accuracy of data. Efforts to determine if such a concentration gradient did actually exist were inconclusive, due mainly to the relatively large variations in air velocity from point to point in the vent. As a result, the data of table ____ have a high degree of uncertainty, and probably should be considered more of a qualitative than quantitative nature.

The results of table ____ indicate that as much as 20 to 40% of the released uranium hexafluoride may leave the building through the roof vent in the form of reaction products, probably uranyl fluoride. The low result obtained

~~UNCLASSIFIED~~ in run 44 as compared to the other six tests is unexplained; this was

~~CONFIDENTIAL~~
another test in which no alarms were obtained.

TABLE

~~CONFIDENTIAL~~

ESTIMATE OF PERCENTAGE OF RELEASED URANIUM HEXAFLUORIDE VENTED TO
ATMOSPHERE

Run Number	44	8	42	40	7	39	16
Release Rate, g UF ₆ /min	10	11.7	20	50	78.3	100	104
Duration of Release, min	15	35	15	15	16	15	16
Total Release, g UF ₆	150	404	300	750	1,252	1,500	1,656
Alpha Activity at Cell 9 Building Vent, cts/min/cu ft	4.67	64.5	45.69	133.0	13.70	189.0	203.0
Uranium Concentration at Cell 9 Building Vent, µg/cu ft	6.30	87.08	61.68	179.6	18.50	255.2	274.1
Duration of Air Sampling, min	30	43	30	30	355	30	30
Total Uranium (Calculated as Uranium Hexafluoride) exiting Cell 9 Vent, g	8.0	159.4	78.8	229.5 22.95	279.1	326.1	350.2
Percentage of Released Uranium Hexafluoride	5.3	39.4	26.3	30.6	22.3	21.7	21.1

67.6% UF₆ = U

$$28,800 \text{ CFM} \cdot \frac{11 \text{ g}}{\text{cu ft}} \cdot 15 \text{ min} \times 10^{-6} \frac{\text{g}}{\text{ug}}$$

$$= 0.43 * \frac{11 \text{ g}}{\text{cu ft}} \left(\frac{\text{g}}{\text{min}} \right) \frac{1}{15}$$

$$28,800 \text{ CFM} \cdot \frac{11 \text{ g}}{\text{cu ft}} \cdot \text{air sampling minutes} \cdot 10^{-6} \frac{\text{g}}{\text{ug}}$$

UNCLASSIFIED

gm UF₆ released = 0.676
~~CONFIDENTIAL~~

$$\frac{\text{gm U}}{\text{gm UF}_6}$$